

OHIO RIVER BASIN PRECIPITATION FREQUENCY PROJECT

Update of *Technical Paper No. 40, NWS HYDRO-35* and *Technical Paper No. 49*

Twentieth Progress Report
1 July 2004 through 30 September 2004

Office of Hydrologic Development
U.S. National Weather Service
National Oceanic and Atmospheric Administration
Silver Spring, Maryland

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DISCLAIMER

The data and information presented in this report are provided only to demonstrate current progress on the various technical tasks associated with this project. Values presented herein are NOT intended for any other use beyond the scope of this progress report. Anyone using any data or information presented in this report for any purpose other than for what it was intended does so at their own risk.

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1. Introduction

The Hydrometeorological Design Studies Center (HDSC), Hydrology Laboratory, Office of Hydrologic Development, U.S. National Weather Service has updated its precipitation frequency estimates for the Ohio River Basin and surrounding states. Previous precipitation frequency estimates for this area were contained in *Technical Paper No. 40* "Rainfall frequency atlas of the United States for durations from 30 minutes to 24 hours and return periods from 1 to 100 years" (Hershfield, 1961), *NWS HYDRO-35* "Five- to 60-minute precipitation frequency for the eastern and central United States" (Frederick et al., 1977) and *Technical Paper No. 49* "Two- to ten-day precipitation for return periods of 2 to 100 years in the contiguous United States" (Miller et al., 1964). The new project included collecting data and performing quality control, compiling and formatting datasets for analyses, selecting applicable frequency distributions and fitting techniques, analyzing data, mapping and preparing reports and other documentation.

The project determined annual all-season precipitation frequencies for durations from 5 minutes to 60 days, for average recurrence intervals from 2 to 1,000 years. The project reviewed and processed all appropriate rainfall data for the project area and used accepted statistical methods. The project results are published as Volume 2 of NOAA Atlas 14 on the internet (<http://www.nws.noaa.gov/ohd/hdsc>) with the additional ability to download digital files.

The project produced estimates for 13 states. Parts of nine additional bordering states were included in the original analysis to ensure continuity across state borders. The core and border areas and regional groups used for long duration (24-hour through 60-day) analyses are shown in Figure 1. Regional groups used for short duration (60-minute through 12-hour) analyses are shown in Figure 2.

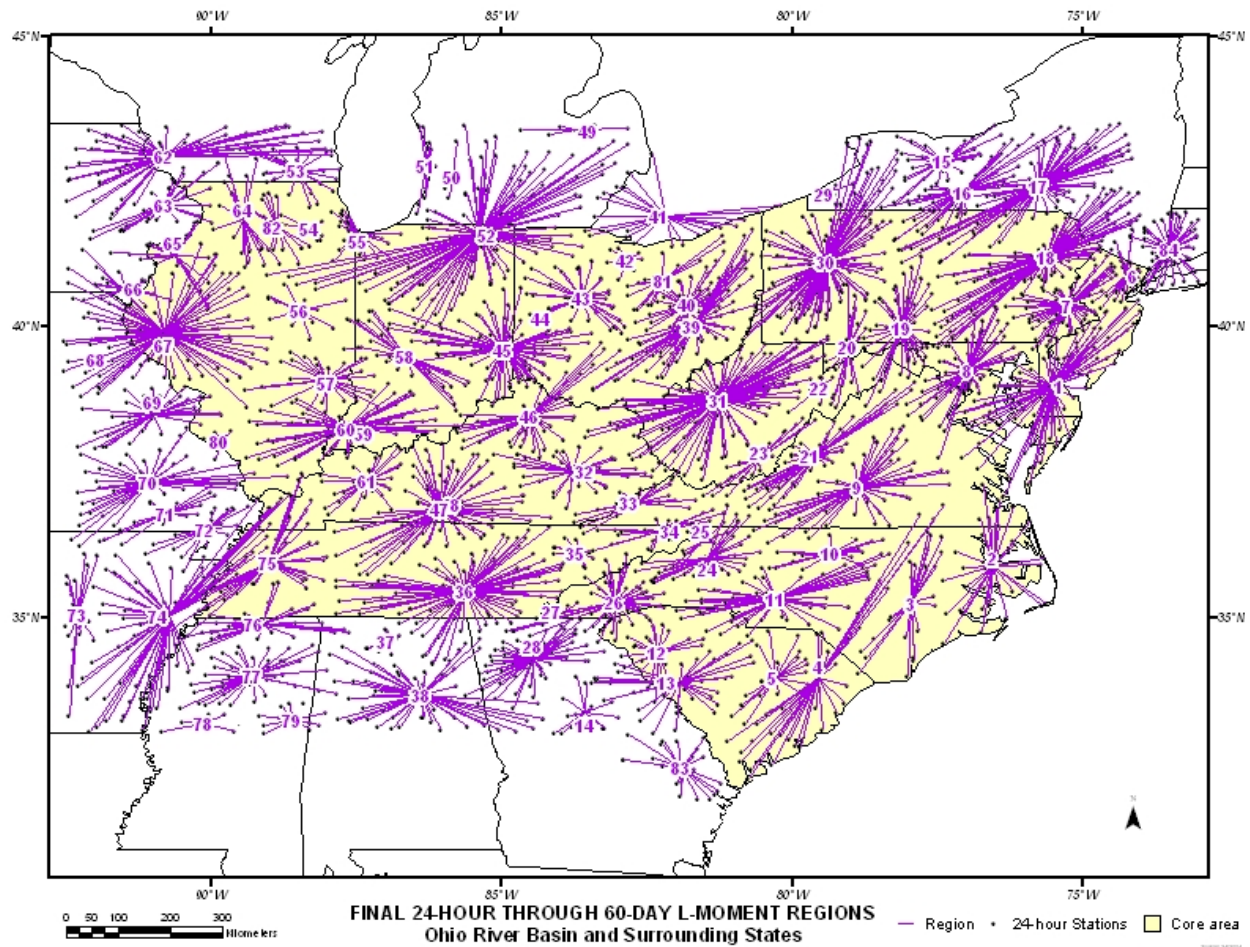


Figure 1. Ohio River Basin project area and 84 daily regional groups.

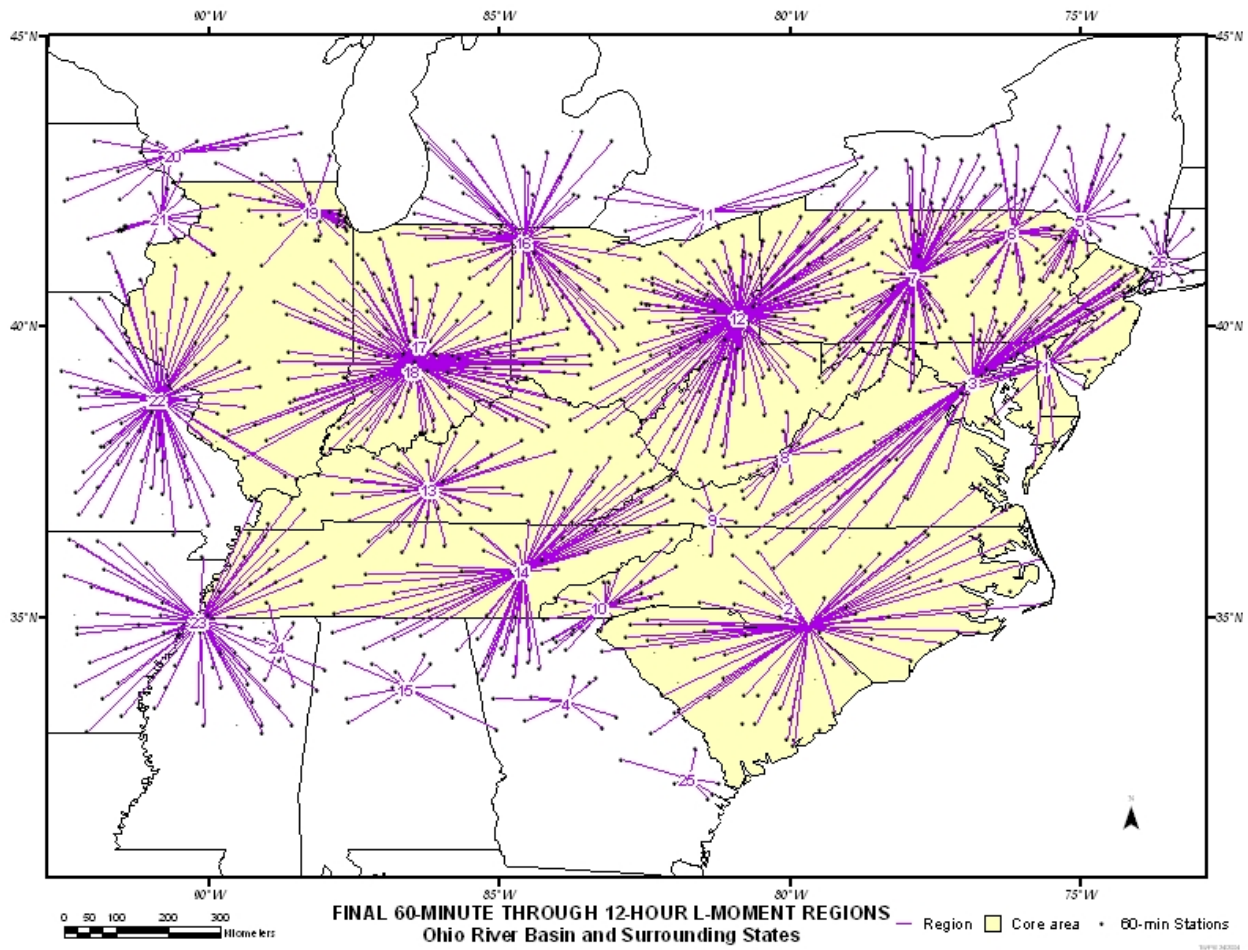


Figure 2. Ohio River Basin project area and 26 hourly regional groups.

2. Highlights

Cartographic maps for all durations (5-minute through 60-day) and all average recurrence intervals (2-year through 1,000-year) for NOAA Atlas 14 Volume 2 are now available on-line at http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_data.html. Additional information is provided in Section 3.1, Final Results.

The difference between 2 extraction procedures for the partial duration series (PDS) was examined. It was found that both procedures produced similar results. Additional information is provided in Section 3.2, PDS Extraction.

The Precipitation Frequency Data Server (PFDS) - the on-line portal for all NOAA Atlas 14 deliverables and information - underwent several subtle, but important changes. Additional information is provided in Section 3.3, PFDS.

Progress continues in the development of geographically-fixed Areal-Reduction-Factor (ARF) curves for basin area sizes of 10 to 400 square miles. Development and testing of software is 90% complete. An additional study area (Santa Barbara County, CA) has been added and two other study areas (Ventura County, CA and Chickasha, OK) are being considered. There are currently 12 study areas located throughout the conterminous U.S., Hawaii, and Puerto Rico that have been quality controlled, processed and ready for ARF analysis. Additional information is provided in Section 3.4, Areal Reduction Factors.

3. Progress in this Reporting Period

3.1 Final Results

On September 27, 2004 the complete set of NOAA Atlas 2 Volume 2 (Ohio River basin and surrounding states) color cartographic-quality maps were posted to the PFDS. The cartographic maps for all durations (5-minute through 60-day) and all average recurrence intervals (2-year through 1,000-year) for NOAA Atlas 14 Volume 2 are available on-line at http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_data.html.

The maps cover multi-state groupings of the domain for publishing purposes. The project area was divided into five such groupings. The following matrix (Table 1) lists the cartographic maps that are available for each grouping in the Ohio River Basin and Surrounding States Project.

Table 1: Matrix of cartographic maps available on the PFDS.

Average Recurrence Interval Duration	2-year	5-year	10-year	25-year	50-year	100-year	200-year	500-year	1,000-year
5-minute	✓	✓	✓	✓	✓	✓	✓	✓	✓
10-minute	✓	✓	✓	✓	✓	✓	✓	✓	✓
15-minute	✓	✓	✓	✓	✓	✓	✓	✓	✓
30-minute	✓	✓	✓	✓	✓	✓	✓	✓	✓
60-minute	✓	✓	✓	✓	✓	✓	✓	✓	✓
120-minute	✓	✓	✓	✓	✓	✓	✓	✓	✓
3-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓
6-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓
12-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓
24-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓
48-hour	✓	✓	✓	✓	✓	✓	✓	✓	✓
4-day	✓	✓	✓	✓	✓	✓	✓	✓	✓
7-day	✓	✓	✓	✓	✓	✓	✓	✓	✓
10-day	✓	✓	✓	✓	✓	✓	✓	✓	✓
20-day	✓	✓	✓	✓	✓	✓	✓	✓	✓
30-day	✓	✓	✓	✓	✓	✓	✓	✓	✓
45-day	✓	✓	✓	✓	✓	✓	✓	✓	✓
60-day	✓	✓	✓	✓	✓	✓	✓	✓	✓

To summarize, NOAA Atlas 14 Volume 2 results for the Ohio River basin and surrounding states include:

1. precipitation frequency point estimates (via the point-and-click interface), including upper and lower limits
2. ArcInfo ASCII grids including upper and lower limits
3. GIS shapefiles including upper and lower limits
4. cartographic maps: all possible combinations of frequencies (2-year to 1,000-year) and durations (5-minute to 60-day) for each state
5. associated metadata

6. time series used in the analyses: annual maximum series and partial duration series
7. temporal distributions of extreme rainfall (6-hour, 12-hour, 24-hour and 96-hour)
8. seasonal graphs: counts of events that exceed the 2-year, 10-year, 25-year, 100-year return intervals for the 60-minute, 24-hour, 48-hour, and 10-day durations.

3.2 PDS Extraction

A partial duration series (PDS) is constructed by taking all of the highest cases above a threshold regardless of the year in which the case occurred. For this project, PDS consisted of the N largest cases in the period of record, where N is the number of years in the period of record at the particular observing station. Such a series is also called an annual exceedance series (AES) (Chow et al., 1988). A new extraction procedure for an AES was compared to the current procedure (described below). The difference between the 2 extraction procedures was examined and it was found that both procedures produced similar results.

In the current extraction procedure (AES1), the maximum precipitation for each month was selected and then sorted in descending order for the 1-day and 2-day durations. For longer durations, a pre-defined number of cases were selected in each year and sorted. The highest N values were then extracted from these cases based on the number of actual years of record for that station. However, an alternative extraction procedure (AES2), considers an unlimited number of maxima from each year regardless of month or pre-defined number of cases in each year. The cases for consideration in this procedure were required to be separated by at least one dry day. A comparison showed that precipitation frequency estimates derived from each extraction procedure were not different. In fact, for the 1-day, 7-day and 30-day durations that were tested in all 59 regions in the project area, the AES2/AES1 ratio varied roughly between 0.988 and 1.015. Future work will include investigating the Ohio Project area.

3.3 Precipitation Frequency Data Server

The Precipitation Frequency Data Server (PFDS) - the on-line portal for all NOAA Atlas 14 deliverables and information - underwent several subtle, but important changes. They include:

1. Several frequently asked questions were added to the FAQ page (http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_faq.html)
2. The text on the Seasonality graph axis was changed to be consistent in terminology
3. Updated README file that resides in each of the state- and region-specific anonymous ftp directories

4. Redesigned version table on “GIS Data and Maps” page (http://hdsc.nws.noaa.gov/hdsc/pfds/pfds_data.html) making it clearer which version number is associated with which project
5. Updated NA14 documents web page with table and links to the various pdf files representing the difference sections of the draft NOAA Atlas 2 Volume 1 documentation
6. Added Time Series button to state-specific pages
7. Modified state-specific pages without updated data to include links to newly posted scanned documents available via the Current PF Publications page (<http://www.nws.noaa.gov/ohd/hdsc/currentpf.htm>)
8. 5-year and 10-year exceedances were added to the seasonality graphs

HDSC continuously monitors the hits, integrity and performance of the PFDS, which receives an increasing number of hits per month. The graph (Figure 3) below summarizes the number of individual data inquiries made on both the Semiarid Project results and the Ohio Project results, which officially came on-line on June 29th, 2004. The included map (Figure 4) indicates the locations of inquiries during the past quarter.

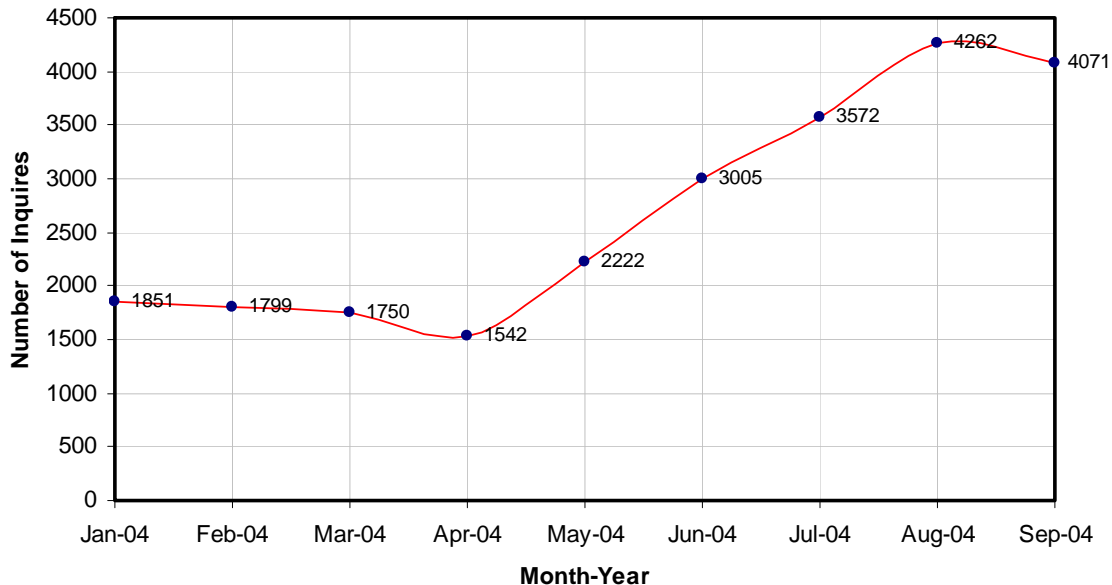


Figure 3: Number of individual PFDS data inquiries per month.

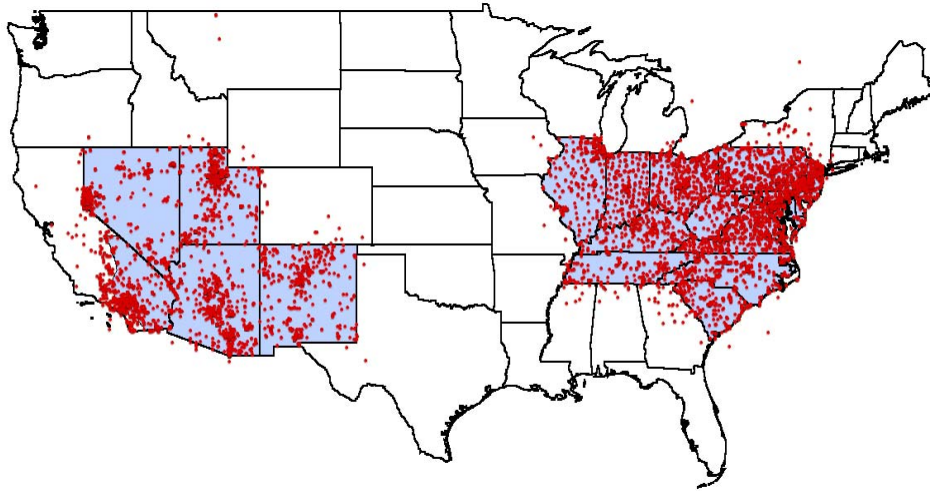


Figure 4: Map of 11,905 PFDS data inquiry locations during the period July-September 2004.

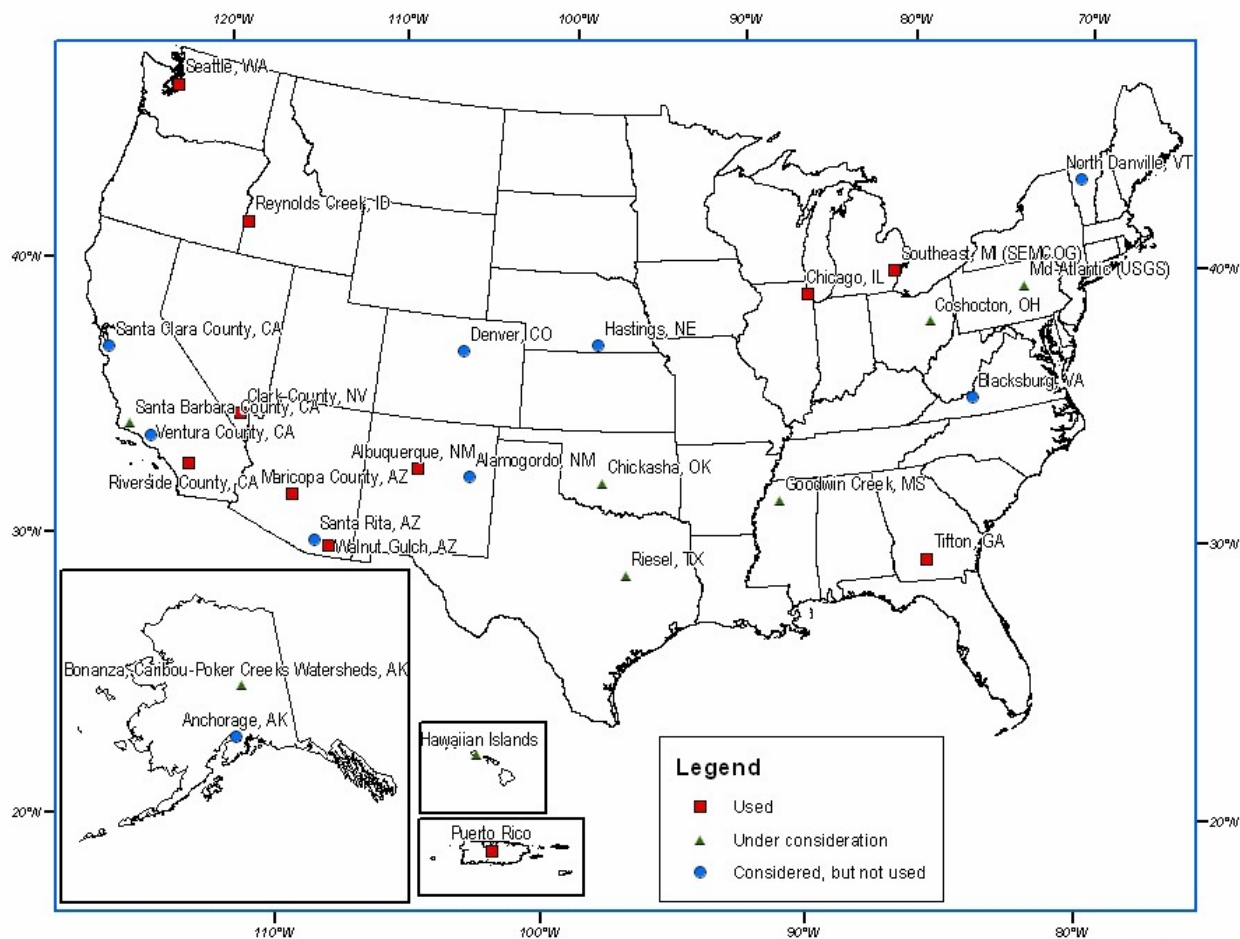
3.2 Areal Reduction Factors

Progress continues in the development of geographically-fixed Areal-Reduction-Factor (ARF) curves for basin area sizes of 10 to 400 square miles. Development and testing of software from the procedure described in NOAA Technical Report NWS 24 continues and is 90% completed.

An additional study area (Santa Barbara County, CA) has been added to the list of areas that could be used to develop the final set of ARF curves. Quality control is being performed and will be completed shortly on the precipitation data from this site. Two other study areas (Ventura County, CA and Chickasha, OK) are also being considered. The Blacksburg, VA study area has been eliminated as one of the sites to be analyzed because it lacks sufficient station density.

There are currently 12 study areas located throughout the conterminous U.S., Hawaii, and Puerto Rico that have been quality controlled, processed and ready for ARF analysis (see Figure 5). The “not used” study areas indicated in Figure 5 were considered but judged inadequate for the study due to poor data, limited or no metadata, or other problems. The set of ARF curves developed for each study area used will be tested for differences to determine if a single set of ARF curves can be used for the entire U.S. as is the case today or whether separate curves for different regions of the country are more appropriate.

Figure 5: Map of ARF study areas



TWP 10/25/2004

4. Issues

4.1 Recent and Upcoming Presentations

Past and future presentations by HDSC, include the following:

- “Recent Updates to NOAA/NWS Rainfall Frequency Atlases” at the California Extreme Precipitation Symposium in Davis, CA on July 1, 2004
- An update of the Ohio River Basin and Surrounding States Precipitation Frequency Project progress at the 84th Meeting of the Ohio River Basin Commission on July 14, 2004
- “Recent Updates to NOAA/NWS Rainfall Frequency Atlases” at the Colorado Association of Stormwater and Floodplain Managers (CASFM) Annual Conference in Glenwood Springs, Colorado on September 23-24, 2004

5. Projected Schedule and Remaining Tasks

The following list provides a tentative schedule with completion dates. Brief descriptions of tasks being worked on next quarter are also included in this section.

Final Documentation [December 2004]
Spatial Relations (Areal Reduction Factors) [January 2005]

5.1 Final Documentation

Draft final documentation was recently published for the Semiarid Project. During the next quarter, this text will be modified to reflect the Ohio Project.

5.2 Areal Reduction Factors (ARF)

Computations for the ARF curves will be completed in the next quarter for 12 areas. The resulting curves will be tested for differences to determine if a single set of ARF curves is applicable to the entire U.S. or whether curves vary by region.

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